

## SECTION 613 DRAINAGE CONDUITS

### 613.01. DESCRIPTION.

This work shall consist of the construction of pipe conduits of the type shown on the Plans in accordance with these Specifications and in reasonably close conformity with the lines and grades shown on the Plans or established by the Engineer. Included are the following:

- pipe underdrains 4 inches (100 mm) in diameter or greater
- all other pipe with an inside diameter of 12 inches (300 mm) or greater which is used in storm drains and culverts, or in drainage conduits not defined as bridges.

### 613.02. MATERIALS.

Drainage conduit shall be of the kind specified on the Plans and shall meet the requirements of Section 726. The class of reinforced concrete pipe—and the sheet thicknesses of the corrugated steel and corrugated aluminum pipe for various diameters and heights of fill above the top of pipes—shall be as shown on the standard drawings. When the class of reinforced concrete culvert pipe is not specified, it shall be Class III.

When not specified on the Plans, the kind of pipe will be optional, but the same kind of pipe shall be used throughout any one project, unless otherwise approved in writing by the Engineer.

Joint filler and cover materials shall meet the requirements specified in the following Subsections of Section 700 - Materials:

Joint Filler	726.02(a)
Cover Material For Pipe Underdrains	703.04

The type, size, class and quantity of pipe to be installed by jacking shall be as specified on the Plans.

### 613.04. CONSTRUCTION METHODS.

- (a) **General.** Begin construction of all pipe conduit at the outlet or the low point in the line. When the construction involves the building of main or submain drainage conduit having one or more laterals or tributaries, do not start the construction of tributary lines until the main or submain drainage conduit has been completed to the point where the tributary or laterals discharge into it.

Adhere to the installation practices shown on the Plans. Any conduit cracked or deformed prior to final acceptance shall be replaced at the Contractor's expense.

During the construction, make adequate provisions for drainage of the system.

Make the connection of storm drain appurtenances to other storm drain appurtenances in accordance with the Plans or in a manner approved by the Engineer. Do the work in a workmanlike manner in such a way as not to damage any of the structures involved. Do not have storm drain conduit project beyond the inside wall line of other sewers or of sewer appurtenances. The grade line shown on the Plans or established by the Engineer is the

elevation of the invert or flow line of the drain. As a rule, accurately establish the center and grade lines in the trench at intervals of not more than 25 feet (10 meters); however, when using a laser device to establish line and grade, you may increase the interval to 50 feet (15 meters)—with the exception that when laying out a manhole or appurtenance the first interval shall be set at 25 feet (10 meters).

Close dead ends of all conduits or drains, wyes, tees, etc. with approved stoppers securely cemented in place. The cost of stoppers (plugs) shall be included in cost of other items. When work is stopped temporarily on storm drains 24 inches (600 mm) in diameter and smaller, use a non-watertight stopper to close the end of the pipe to prevent trash or debris from entering it.

- (b) **Excavation.** Except by special permission from the Engineer, the amount of trench excavated at any time shall not exceed the amount in which pipe conduit can be set and the trench backfilled in two calendar days. Where conduits are to be placed in embankment fill, make the trench excavation after the embankment has been completed to a height specified on the Plans above the design flowline grade for those conduits.

The width of trench excavation at the bottom of the trench shall conform to the dimensions shown on the standard pipe and/or box installation drawings. Trench excavation shall be of the width specified thereon for at least 2 feet (0.6 meters) above the top of the conduit.

Excavate bell holes, or recesses for bells of the pipe, at every joint, and make them of sufficient size and depth to relieve the bell of all load; this is to permit the barrel to be firmly bedded throughout its length and to provide ample space for forming the joint.

*NOTE: Filling and ramming earth or other material beneath the pipe to raise it to grade will not be permitted.*

Where a concrete cradle or refill is shown on the Plans or required by the Engineer, place it in conformity with the Plans and Specifications; it shall consist of Class A concrete meeting the requirements of Section 701.

Make the completed trench bottom firm for its full length and width. Remove any soft and yielding material encountered in the trench bottom and replace it with suitable material, as directed by the Engineer; it is to be paid for as trench excavation for removal and standard bedding material for backfilling. Where required, in the case of cross drains, the trench shall have a longitudinal camber of the magnitude specified.

Unless otherwise specified, all excavation and removed materials not used in the project embankment or as backfill around structures shall become the property of the Contractor, who will dispose of them. This disposal of excess material will not be measured and paid for separately, but will be considered incidental to the various classes of excavation and removal.

All trench excavation will be considered unclassified excavation as defined in Section 202.

- (c) **Bedding.** When bedding is not specified on the Plans, use Class B for rigid conduits and Class C for flexible conduits. Classes of bedding are as follows:
- (1) **Class A.** Consists of a continuous concrete cradle conforming to the Plan details.
  - (2) **Class B.** Meets the requirements of Subsection 27.5.2 of the current AASHTO Standard Specifications for Highway Bridges and conforms to the requirements of Section 703.06.

- (3) **Class C.** Consists of bedding the conduit to a depth of not less than 10 percent of its total height, the bed shaped to fit the conduit and having recesses shaped to receive the bell, and meets the requirements of Subsection 703.06.
- (4) **Underdrain Bedding.** Consists of a bedding layer of granular backfill material meeting the requirement of Subsection 703.04 compacted in the bottom of the trench for its full width and length as shown on standard drawings for pipe underdrain.
- (d) **Laying Pipe.** Place pipe on an approved foundation to true line and grade, with the bell facing upstream, in a manner that will not change the conduit.

*NOTE: No buckling in or laying pipe downgrade will be permitted. Do not drop pipe to the bottom of the trench; instead, lower it and place it in its final position using hoisting equipment adequate to handle the pipe without damage to the pipe or trench. Replace any damaged pipe at no additional cost. Clean the inside of the barrel before the pipes are lowered into the trench.*

Begin laying conduit at the downstream end of the conduit line. The lower segment of the conduit shall be in contact with the shaped bedding throughout its full length. Place bell or groove ends of rigid conduits and outside circumferential laps of flexible conduits facing upstream.

Lay paved or partially-lined conduit so that the longitudinal center line of the paved segment coincides with the flow line. Place elliptical and elliptically-reinforced conduits with the major axis within five degrees of a vertical plane through the longitudinal axis of the conduit.

Firmly embed underdrain pipe in the bedding material, and lay it reasonably true to the established line and grade. Lay perforated (round holes or elongated slots) pipe with perforations down. Lay pipe underdrain with a top of pipe identification with the marker up in all installations.

Form and securely fasten metal screens to the outlet end of the subdrain pipe. They will have 1/2 inch (12 mm) mesh size openings composed of either 0.04 inch (1 mm) or 0.08 inch (2 mm) diameter steel wire (after galvanization) meeting the requirements of ASTM A 740. Permanently seal the dead end of the pipe with end caps.

After the pipe has been inspected and approved, carefully cover it with cover material and/or backfill material as shown on current standard drawings, taking care in placing cover materials to prevent displacement or damage to the pipe.

Furnish and set a marker post at the outlet of all pipe underdrains. (See details as shown on standard drawings.) Included costs in the contract unit price per meter of pipe underdrain.

- (e) **Joining Pipe Conduit.** Rigid conduits may be of bell, spigot, or tongue-and-groove design unless one type is specified. The method of joining conduit sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush and even.

Make joints with mortar, cold applied mastic, rubber gaskets, or plastic joint material—in accordance with the appropriate Specifications for the type of pipe being used. Take care that the joints are concentric, reasonably watertight, and free from superfluous joint material on the inside of the pipe. Join flexible conduit by an approved external or internal coupling device (separate item), or by an approved twist-lock coupling system integrated into the wall of the

conduit. To prevent separation during installation, handling, and backfilling operations, join the coupling system firmly and solidly to the conduit.

The performance of the coupling system under field conditions will determine its acceptability; repeated releases of any system will be cause for rejection.

*NOTE: The Engineer has the right of approval or rejection of any coupling system, regardless of its presence or absence on an approval list elsewhere.*

- (f) **Backfilling.** Before any backfill is placed, the conduit shall be inspected by the Engineer. Inside joints shall be smooth and barrels clean. If pipe is found to be out of alignment, unduly settled, or damaged, take it up and relay or replace it before backfilling. Place standard bedding material over all pipe except pipe underdrain to the depth shown on the Plans. Place and uniformly compact backfilling in accordance with Subsection 202.02(b).
- (g) **Jacking Pipe Conduit.** Only when shown on the plans, designated in the Contract, or approved by the Engineer shall conduit of any nature be placed by jacking, boring, or pushing. Where jacking or boring has been designated, place the conduit to a true line and grade. Unless otherwise specified, the methods and equipment used in jacking and boring conduit shall be optional, provided that the proposed method is approved by the Engineer. Investigate the area of placement, being careful not to interfere with existing underground utilities under the roadway or adjacent to the jacking operation. Take care also to keep the disturbed area of construction to a minimum.

Unless otherwise shown, install bored, pushed, or jacked conduits a minimum depth of 18 inches (460 mm) below the top of ground line or subgrade, as applicable. Where conduit passes under a surfaced area, cut an "X" in the curb or surfacing above the conduit crossings for future relocating purposes.

The use of water or other fluids in connection with the boring or jacking operation will be permitted only under unusual conditions as determined by the Engineer and only on his written approval. The water or other lubricant used as the circulation medium authorized under these conditions must be applied without the use of undue pressure and retained within the casing as the boring or jacking progresses.

Where conduit is required to be installed under railroad embankments or under highways, streets, or other facilities by jacking methods, do not allow the work to interfere with the operation of the railroad, street, highway, or other facility, and do not weaken or damage any embankment or structure.

Conduit to be placed by jacking shall be of the size, type, and class specified on the Plans, except that the strength of the conduit designated in the Contract is determined for not less than final loading, complete in place under the embankment. Additional reinforcement or strength of conduit required to withstand jacking pressure shall be the responsibility of the Contractor, and any such extra-strength conduit required shall be at the Contractor's expense.

Conduit larger than 2 inches (50 mm) inside diameter shall not be pushed or jacked under the highway, railroad, or street without boring or otherwise removing the soil as the conduit is advanced. Conduit up to 36 inch (915 mm) inside diameter shall be constructed by a combined

method of boring and jacking. The boring auger or bit shall have a smaller diameter than the specified diameter of the conduit to be jacked.

The conduit shall be jacked as the boring auger drills out the material, with excavation ahead of the conduit not exceeding 1 foot (0.3 meter).

If the grade of the conduit at the jacking end is below the ground surface, excavate suitable pits or trenches for the purpose of conducting the jacking so as to prevent earth caving. Dewatering, if necessary, shall be continuous until the backfill is made. All costs involved in the performance of the work of constructing pilot tunnels shall be included in the contract unit price for jacking conduit.

Provide heavy-duty jacks suitable for forcing the conduit through the embankment. When operating jacks, apply even pressure to all jacks used. Provide a suitable jacking head, usually of timber, and suitable bracing between jacks and jacking head, so that pressure will be applied to the conduit uniformly around its ring. Also provide a jacking frame or back stop. Set the conduit to be jacked on guides, properly braced together, to support the section(s) of conduit and to direct it in the proper line and grade. When sections of conduit are less than 6 feet (2 meters) in length, carefully place two sections in the guide frame with joints so lubricated as to minimize the possibility of breakage. Place the whole jacking assembly so as to line with the direction and grade of the conduit. In general, excavate earth material just ahead of the conduit and remove the material through the conduit; then the conduit can be forced through the embankment with jacks into the space thus provided.

The excavation for the underside of the conduit, for at least 1/3 of the circumference of the pipe, shall conform to the contour and grade of the conduit. Except as provided herein below, a clearance of not more than 2 inches (50 mm) may be provided for the upper half of the conduit. The clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the conduit.

The Contractor may provide a steel cutting edge around the head and for not less than the upper 2/3 of the conduit and extending a short distance beyond the end of the conduit. Construct the steel cutting edge, and mount and use it so as to insure that clearance between the outside of the conduit and the undisturbed earth will be not more than 1/2 inch (12 mm). Excavation inside the pipe shall not exceed the outside diameter of the conduit, nor extend more than 12 inches (300 mm) beyond the lead edge of the cutting head; this provides for final trimming by the cutting edge and eliminates any void space except that clearance permitted above regarding the steel cutting head.

When jacking of the conduit is begun, carry out the operation without interruption, as far as practicable, to prevent the conduit from becoming firmly set in the embankment.

*NOTE: Any evidence at any time of caving shall require that the operation be discontinued until provisions are made for eliminating such caving and the location of any cavity identified.*

Fill all cavities formed by caving or any voids resulting from excavation larger than the pipe diameter with grout in a manner approved by the Engineer.

Remove any conduit damaged in jacking operations, and replace it at the Contractor's expense.

- (h) **Removing and Replacing Railway Track.** When the area has been cleared, immediately proceed with the trench excavation, Class B bedding, and laying the pipe, as shown on the Plans and in accordance with the Specifications.

Backfill in accordance with Subsection 613.04(f) except that the standard bedding material and approved backfill material shall be placed in 4 inch (100 mm) layers (loose measurement) and compacted with approved mechanical tampers in accordance with Subsection 202.02(b).

*NOTE: Flooding the trench will not be permitted.*

Upon satisfactory completion of the backfill, the railway company shall restore its ballast, ties, and tracks.

The railway company will be reimbursed for removing and replacing the necessary trackage, ballast, and ties in accordance with a force account agreement with the Department.

### 613.05. METHOD OF MEASUREMENT.

No deductions will be made for wye branches; and on conduits 12 inches (300 mm) or less in diameter, no deductions will be made for standard manholes. On the other hand, deductions will be made for special structures, unless otherwise shown on the Plans; and on conduits larger than 12 inches (300 mm) in diameter, deductions will be made for all manholes and for all structures. Conduits which extend only through the wall of the structure will be measured to the actual end of the pipe—except as provided above for measuring conduits 12 inches (300 mm) or less in diameter through standard manholes.

- (a) **Items Measured:**

*Drainage conduit* will be measured by the linear foot (meter) along the center line of the conduit actually laid. Conduit with sloped or skewed ends will be measured along the invert or as shown on the Plans.

*End sections* will be measured by the number of units installed.

*Standard bedding material* will be measured by the cubic yard (cubic meter) calculated on a theoretical basis with the height as shown on the Plans above and below the design flowline, the width inside the vertical neat lines of the trench as defined in Subsection 613.04(b), the length as that measured for the drainage conduit and deducting the volume displaced by the conduit calculated from the nominal designated outside diameter of the pipe, pipe arch or elliptical pipe, or precast box conduit.

*Pipe underdrain cover material*, other than earth, will be measured by the cubic yard (cubic meter) of pipe underdrain cover material placed and accepted and based on Plan width and established depth of the trench with no deduction for the volume of the underdrain pipe.

Trench excavation will be measured by the cubic yard (cubic meter) calculated on a theoretical basis of the volume of material defined as follows:

*The depth* in cut areas will be the average depth measured from the lower excavation line specified (below the conduit flowline as shown on the pipe or box installation standard drawings) to the finished subgrade. The depth in fill areas will be measured from the lower excavation line to a distance 2 feet (0.6 meter) above the top of conduit. The Engineer shall establish an equitable measurement elevation in areas requiring both excavation and embankment in adjacent

areas. Thickness of rigid conduit will be the actual measured thickness, while thickness of flexible conduit will be the height of corrugation or wall thickness of the type of conduit used when calculating the dimension below the flow line for establishing the datum plane.

The length will be that measured for the drainage conduit.

The width will be measured inside the vertical neat lines of the trench defined in Subsection 613.04(b).

The conduit of the size and type as shown on the Plans and constructed by jacking as specified above will be measured by the linear foot (linear meter) along the center line of the conduit actually jacked in place and accepted. The cost of the conduit shall be included in the cost of jacking.

**(b) Items Usually Not Measured:**

Joint filler for pipe will not be measured for payment, but the cost will be included in other bid items.

Earth backfill, sheeting, and shoring will not be measured for payment.

Concrete cradles, if specified, will not be a separate pay item unless otherwise provided.

**613.06. BASIS OF PAYMENT.**

The accepted quantities of drainage conduit of the types and sizes specified, measured as provided above, will be paid for at the contract unit price as follows:

(A)	NON-REINFORCED CONCRETE PIPE .....	LINEAR FOOT (METER)
(B)	REINFORCED CONCRETE PIPE, ROUND, ELLIPTICAL OR ARCH .....	LINEAR FOOT (METER)
(C)	SPECIAL END SECTIONS OF REINFORCED CONCRETE .....	EACH
(CC)	CULVERT END TREATMENT .....	EACH
(D)	CORRUGATED GALVANIZED STEEL PIPE, ROUND OR ARCH .....	LINEAR FOOT (METER)
(E)	CORRUGATED GALVANIZED STRUCTURAL PLATE PIPE, ROUND OR ARCH .....	LINEAR FOOT (METER)
(F)	PRECOATED CORRUGATED STEEL PIPE, ROUND OR ARCH .....	LINEAR FOOT (METER)
(G)	GALVANIZED STEEL CULVERT END SECTIONS, ROUND OR ARCH .....	EACH
(H)	CORRUGATED ALUMINUM PIPE, ROUND OR ARCH .....	LINEAR FOOT (METER)
(I)	ALUMINUM STRUCTURAL PLATE PIPE, PIPE ARCHES AND ARCHES .....	LINEAR FOOT (METER)
(J)	ALUMINUM END SECTIONS, ROUND OR ARCH .....	EACH
(K)	PIPE FOR CROSS DRAIN**, ROUND OR ARCH .....	LINEAR FOOT (METER)
(L)	PIPE FOR SIDE DRAIN*, ROUND OR ARCH .....	LINEAR FOOT (METER)
(M)	PREFAB. CULV. END SEC., ROUND OR ARCH .....	EACH
(MM)	SLOPED CONCRETE END SECTION .....	EACH
(N)	VITRIFIED CLAY PIPE .....	LINEAR FOOT (METER)

(O)	PVC PIPE .....	LINEAR FOOT (METER)
(P)	PERFORATED PIPE UNDERDRAIN .....	LINEAR FOOT (METER)
(Q)	NON-PERFORATED PIPE UNDERDRAIN .....	LINEAR FOOT (METER)
(R)	PIPE UNDERDRAIN COVER MATERIAL .....	CUBIC YARD (CUBIC METER)
(S)	TRENCH EXCAVATION .....	CUBIC YARD (CUBIC METER)
(T)	STANDARD BEDDING MATERIAL .....	CUBIC YARD (CUBIC METER)
(U)	JACKED CONDUIT .....	LINEAR FOOT (METER)
(V)	CAST IRON PIPE .....	LINEAR FOOT (METER)
(W)	CORRUGATED POLYETHYLENE PIPE .....	LINEAR FOOT (METER)

Such payment shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

\*\* Height of fill to be specified.

\* Conduit for this use shall be minimum class or sheet thickness as shown in Fill Height Table (for metal and concrete conduits) on standard drawings.

## SECTION 614 RELAYING CULVERT PIPE

### 614.01. DESCRIPTION.

This work shall consist of relaying culvert pipe of the type specified on the Plans, at the location, and to the lines and grades shown on the Plans or established by the Engineer.

### 614.04. CONSTRUCTION METHODS

Relay pipe in accordance with the requirements of Section 613. Clean pipe of objectionable material before relaying it.

### 614.05. METHOD OF MEASUREMENT.

Measure the *relaying culvert pipe* by the linear foot (meter) in place. Different sizes and types of pipe shall constitute separate pay items.

### 614.06. BASIS OF PAYMENT.

Accepted quantities for relaying culvert pipe, measured as provided above, will be paid for at the contract unit price as follows:

RELAYING CULVERT PIPE .....	LINEAR FOOT (METER)
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Such payment shall be full compensation for furnishing equipment, labor, and incidentals to complete the work as specified.